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Gross Morphological Changes in Cisplatin Induced Nephrotoxicity among the Wister Albino Rats

Uluma Wanjala Edwin*

Department of Human Anatomy, School of Medicine, Maseno University, Maseno, Kenya.
*Corresponding Author Email: edwinwaja25@gmail.com**

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ABSTRACT

Background: Cisplatin is always used alongside other chemotherapy drugs in management of neoplastic conditions. Despite its clinical effectiveness, it has been associated with acute kidney disease to the patients that uses it. However, there is paucity of data on gross morphological changes on the kidneys following cisplatin induced nephrotoxicity.

Objectives: The study aimed at assessing the gross morphological changes in cisplatin induced nephrotoxicity.

Methodology: The study employed a posttest control experimental study design. Ten animals were randomly separated into two groups of control and experimental groups of five animals each. The control group was only fed and never administered with any drug. The experimental group was administered with stat dose of 0.28mg/kg/bwt/ intraperitoneal cisplatin. On the sixth day all animals were sacrificed.

Results: The study found out that there were significant changes in gross morphology in terms of mean weight, width, volume, thickness and length of the rat's kidney following cisplatin induced nephrotoxicity.

Conclusion: A stat dose of 0.28mg/kg/bwt intraperitoneal cisplatin can cause gross morphological changes in kidneys.

Keywords: Cisplatin; Gross Morphology; Nephrotoxicity; Wister Albino Rats.

1. Introduction

Gross morphometry this are the measurable features such as the volume, thickness, height, width and weight of an organ (Bakker et al., 1998; Emamian et al., 1993). This can help in noticing if there are some changes within an organ such as during an occurrence of a disease or growth (Hansen et al., 2015). Some imaging modalities such the ultrasound have been used in measuring the volume, length, width and the thickness of organs when suspecting pathological process taking place within them such as in Acute and chronic kidney disease, liver diseases, sleep injury and many others (Kang et al., 2007; Lucisano et al., 2015).

Nephrotoxicity is a pathological change in the kidney during an occurrence of a disease or when introduced with a nephrotoxic agent (Venkatesan et al., 2000). Many nephrotoxic agents cause gross morphological changes to the kidney to indicate development of a pathological injury (Kim & Moon, 2012). Some of the organs increases in size and others reduces in size during development of the disease (Ammirati, 2020).

Cisplatin is a neoplastic drug that is used alongside other cancer medication in managing the soft tissue tumors that can affect the testis, cervix, neck, lung, thyroid and other regions of the body (Arany & Safirstein, 2003). Majority of the patients using it have been associated with the kidney disease during the prescription period and therefore it is used with a lot of restriction (Manohar & Leung, 2018). Mostly the kidney disease has been associated with the elderly that uses the cisplatin medication (Launay-Vacher et al., 2008).

This study will help in giving knowledge usage of the gross morphological features such the length, weight, volume, thickness and width of the kidney in assessing the development of nephrotoxicity after administration of cisplatin in the population that uses it. This can be done together with the biochemical parameters.

2. Material and Methods

The study was conducted in a medical institution and followed all the ethical approval process with the following reference numbers UEAB/ISERC/01/2023 and NACOSTI/P/23/23376. The study adopted posttest control experimental study design. Ten albino rats were randomly selected and separated into two groups of five animals each and that was the Control and the Cisplatin group and were put in cages for seven days to acclimatize. The control group was only fed on feeds plus water *adlibitum.* The Experimental group was administered with 0.28mg/ kg/bwt of intraperitoneal cisplatin stat. On the day six of the experiment all animals were humanely sacrificed, blood samples were taken to confirm the changes that would have taken place in the serum urea and creatinine level as a result of cisplatin toxicity. The abdomen was dissected and the kidneys were removed. The kidney weight, thickness, width, length and volume were measured using calipers, rulers and calibrated jars. The volume was measured using the Archimedes immersion principle and the displaced volume was assumed to be the volume of the kidney.

Figure 1. Measuring of the weight, length, width and volume of the kidney

Key: a- weight of the kidney, b- length, c- width and d- volume.

3. Results

3.1. Observed gross anatomy of the kidney of Wister albino rat

On observation, the kidneys were bean shaped and reddish brownish in color located between the intestines anteriorly and the posterior aspect of the peritoneal cavity on sides of the vertebral column. The renal veins and the arteries were connected to the vena cava and the aorta respectively. The left kidneys were more caudal than the right ones and were covered by a connective tissue. The cortex, medulla and renal pelvis were normal in all the groups, this concured with the normal anatomy of winster rats. There were no abnormal variations observed in the kidney gross morphology (Figure 2).

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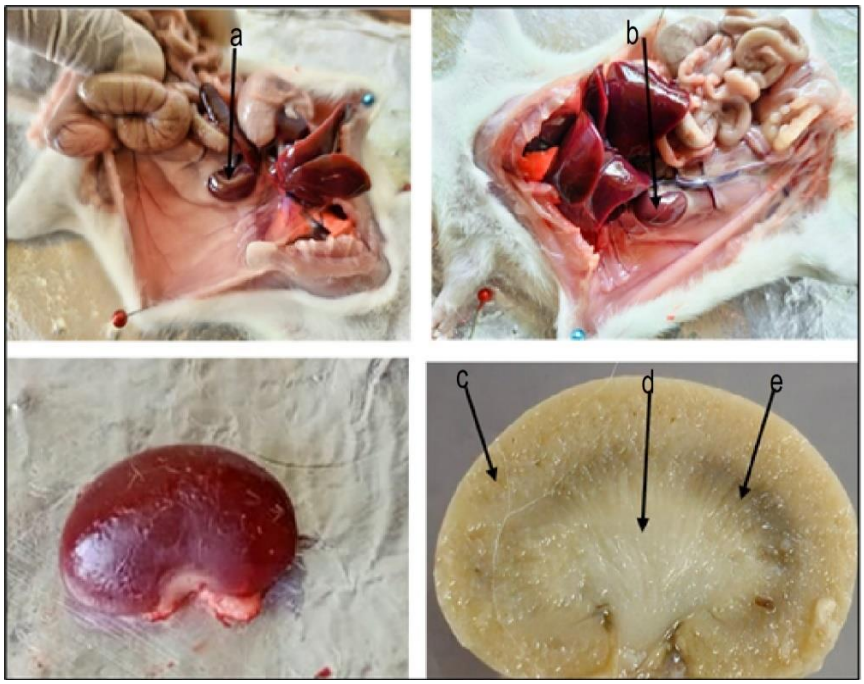

Figure 2. Observed gross anatomy of the Wister albino rats kidneys

Key: a- right kidney, b- left kidney, c- cortex, d- renal pelvis, e- medulla.

3.2. Gross morphometry of Wister albino rats

Table 1. The mean length, volume, weight, width and thickness between the experimental group one and control of the right kidneys

Groups	Mean weight right kidney Mean ± SEM	Mean length right kidney Mean ± SEM	Mean width right kidney Mean ± SEM	Mean volume right kidney Mean ± SEM	Mean thickness right kidney Mean ± SEM
Control (water+ feeds)	1.150 ± .02	18.25±.06	11.35±.10	2.30±.10	5.59±.03
Experimental GP1 (0.28mg/cisplati)	0.894 ± .19	16.28±.65	9.53±.20	1.86±.45	3.39±.80
P Value	< 0.0001**	< 0.0001**	< 0.0001**	< 0.0001**	< 0.0001**

Key: 0.28mg/kg of cisplatin was given to Experimental group one to induce nephrotoxicity. SEM- Standard error of mean, P value less than 0.05 was considered statistically significant.

There was significant (P < 0.0001**) reduction in the mean length, width, volume, thickness and weight of the right kidney for experimental group as correlated with the control group. The P values were tested between the mean difference of the control (water + feeds) and Experimental group one (0.28mg/kg cisplatin) using one way ANOVA and post hoc test (Table 1).

Table 2. The mean length, volume, weight, width and thickness between experimental group one and control of the left kidneys

Groups	Mean weight left kidney Mean ± SEM	Mean length left kidney Mean ± SEM	Mean width left kidney Mean ± SEM	Mean volume left kidney Mean ± SEM	Mean thickness left kidney Mean ± SEM
Control (water+ feeds)	0.91±.01	14.82±.27	9.68±.12	1.61±0.38	4.29±.36

Experimental GP1 (0.28mg/kg Cisplatin)	0.61±.33	12.64±.16	7.68 ± .16	1.23±.31	3.42±.08
P Value	< 0.0001**	< 0.0001**	< 0.0001**	< 0.0001**	< 0.008**

Key: 0.28mg/kg of cisplatin was given to Experimental group one to induce nephrotoxicity, SEM- Standard error of mean, P value less than 0.05 was considered statistically significant.

There was statistical significance (P <0.0001**) reduction in weight, length, width, volume and thickness of the left kidney for experimental group as correlated with the control group. The P value was tested between the mean difference of the control (water + feeds) and Experimental group one (0.28mg/kg cisplatin) using one way ANOVA and post hoc test (Table 2).

3.3. Terminal body weight

Table 3. Mean body weight between experimental group and control group

Groups	**Mean weight of the rats (Mean ± SEM)**
Control group	302 ± 0.60
Experimental group	263 ± 4.27
P value	$P \leq 0.0001$**

Key: 0.28mg/kg of cisplatin was given to Experimental group one to induce nephrotoxicity, SEM- Standard error of mean, P value less than 0.05 was considered statistically significant.

There was significant ($P \leq 0.001$) reduction in mean body weight of experimental group one as compared to the control. The P value was tested between the mean difference of the control (water + feeds) and Experimental group one (0.28mg/kg cisplatin) using one way ANOVA and post hoc test (Table 3).

4. Discussion

4.1. Influence of cisplatin on body and kidney weight

There was a significant reduction of terminal body weight of experimental group compared to the control group, this may have been a result of secondary effects of renal toxicity including anemia and liver failure. Previous studies also reported a gradual reduction in weight in relation to higher doses of nephrotoxic agents (Chen et al., 2014; Yaman & Balikci, 2010). The current findings demonstrated no significant change in daily body weight among the rats of the control group.

4.2. Influence of cisplatin on volume, width, length and thickness of the kidneys

There was a significant reduction in the volume of the kidney for the experimental group one as compared to the control. This might be as a result of the distortion of the glomerulus and necrosis of the epithelium tissues of tubules. This study finding concurred with results of the (Kunogi et al., 2021) who recorded a 25% reduction in volume following cisplatin-induced nephrotoxicity. There was a significant decrease in thickness, width, and length in the experimental group one as compared to the control.

5. Conclusion

The gross morphometry parameters such as the length, width, thickness and volume of the kidney were able to demonstrate Cisplatin induced nephrotoxicity and restoration effects of *Mwarubaini* among the Wister albino rats.

Declarations

Source of Funding

This study did not receive any grant from funding agencies in the public, commercial, or not–for–profit sectors.

Competing Interests Statement

The author has not declared any conflict of interest.

Consent for publication

The author declares that he consented to the publication of this study.

Ethical Approval

The study was conducted in a medical institution and followed all the ethical approval process with the following reference numbers UEAB/ISERC/01/2023 and NACOSTI/P/23/23376.

Authors' contributions

Author’s independent contribution.

References

Ammirati, A.L. (2020). Chronic kidney disease. Revista da Associação Médica Brasileira, 66: s03–s09.

Arany, I., & Safirstein, R.L. (2003). Cisplatin nephrotoxicity. Seminars in Nephrology.

Bakker, J., Olree, M., Kaatee, R., de Lange, E.E., & Beek, F.J. (1998). In vitro measurement of kidney size: comparison of ultrasonography and MRI. Ultrasound in Medicine & Biology, 24(5): 683–688.

Chen, B.L., Wang, L.T., Huang, K.H., Wang, C.C., Chiang, C.K., & Liu, S.H. (2014). Quercetin attenuates renal ischemia/reperfusion injury via an activation of AMP-activated protein kinase-regulated autophagy pathway. The Journal of Nutritional Biochemistry, 25(11): 1226–1234.

Emamian, S.A., Nielsen, M.B., Pedersen, J.F., & Ytte, L. (1993). Kidney dimensions at sonography: correlation with age, sex, and habitus in 665 adult volunteers. American Journal of Roentgenology, 160(1): 83–86.

Hansen, K.L., Nielsen, M.B., & Ewertsen, C. (2015). Ultrasonography of the kidney: a pictorial review. Diagnostics, 6(1): 2.

Kang, K.Y., Lee, Y.J., Park, S.C., Yang, C.W., Kim, Y.S., Moon, I.S., Koh, Y.B., Bang, B.K., & Choi, B.S. (2007). A comparative study of methods of estimating kidney length in kidney transplantation donors. Nephrology Dialysis Transplantation, 22(8): 2322–2327.

Kim, S.Y., & Moon, A. (2012). Drug-induced nephrotoxicity and its biomarkers. Biomolecules & Therapeutics, 20(3): 268.

Kunogi, H., Yamaguchi, N., Terao, Y., & Sasai, K. (2021). Dosimetric predictors of nephrotoxicity in patients receiving extended-field radiation therapy for gynecologic cancer. Radiation Oncology, 16(1): 1–8.

Launay-Vacher, V., Rey, J.B., Isnard-Bagnis, C., Deray, G., & Daouphars, M. (2008). Prevention of cisplatin nephrotoxicity: state of the art and recommendations from the European Society of Clinical Pharmacy Special Interest Group on Cancer Care. Cancer Chemotherapy and Pharmacology, 61: 903–909.

Lucisano, G., Comi, N., Pelagi, E., Cianfrone, P., Fuiano, L., & Fuiano, G. (2015). Can renal sonography be a reliable diagnostic tool in the assessment of chronic kidney disease? Journal of Ultrasound in Medicine, 34(2): 299–306.

Manohar, S., & Leung, N. (2018). Cisplatin nephrotoxicity: a review of the literature. Journal of Nephrology, 31(1): 15–25.

Venkatesan, N., Punithavathi, D., & Arumugam, V. (2000). Curcumin prevents adriamycin nephrotoxicity in rats. British Journal of Pharmacology, 129(2): 231–234.

Yaman, İ., & Balikci, E. (2010). Protective effects of Nigella sativa against gentamicin-induced nephrotoxicity in rats. Experimental and Toxicologic Pathology, 62(2): 183–190.